Sport as a Scaffold to Personal and Social Skills Acquisition in VET Sector Education and Training

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Abstract

Constructivist theory and a case study are used to argue (a) that personal and social skills can be learned through participation in sport, (b) that there can be transfer of skills acquisition from sport to career activity, and (c) that it is likely that formal education and training in the VET sector has not fully utilised the potential of sport for personal and social skills acquisition. It is also suggested that constructivism has not fully investigated sport in education as a defence against the divisive nature of if-it-works-use- it validation and the fact-value divide of moral relativism.

I Introduction

La plus la change, la plus la meme chose: someone's clever original observation about the human penchant for the static, the known, and the secure. But at the same time there is an inquisitive side to humanity and because of this, knowledge advances – sometimes slowly, sometimes in a rush. The growth of knowledge and the advancement of learning seldom, if ever, occur except through concept change and development. Teaching for these (concept change and development) is a big challenge in formal VET education and training.

The conference aim (analysis and discussion of the efficacy of sport (physical education) as a teaching tool for the acquisition of personal and social qualifications needed for becoming successful in one's professional career) is, by inspection, a direct question about how sport (physical education) can be employed in teaching for concept change and development. Each of the four conference topics is inviting[i] but this paper will largely confine itself to the first one – integrating the practice of a sport into formal vocational education and training. Both theory (constructivism, and teaching for conceptual change) and practice (action research case learning from actual participation in a sport-in-VET teaching experiment) will inform the discussion. Except by a footnote reference[ii], or by inference in passing, no detailed discussion will be offered on the vexing and important questions of just what constitutes career success and the nature and use of the personal and social qualifications mix required for success.

2 Educational Theory: Skills Acquisition through Concept Change and Development

2.1 Wide focus (human condition) views of barriers to concept and construct change

Change (in the sense of altered behaviour induced through formal education and training) is really not well understood. Aristotle (1952), in his stunning work (De anima) was among the first known researchers to formalise the complexity involved in human understanding and interpretation of nature. Educationalists setting out today to investigate concept and construct change are bound to meet Aristotle coming back. More recently, Francis Bacon in his *Great Instauration – The Advancement of Learning*: 1605, the *Novum Organon*: 1617, and the *New Atlantis*: 1620 (1952) – was among the first of the moderns to document barriers to change. In the *Novum Organon* Bacon identified four *idols of the tribe* or shortcomings inherent in the tribe of mankind itself. These idols (Table 1 in the Appendix) are implicated in mankind's shadowy grasp of understanding of the nature of things and are inherent in both false understanding and resistance to concept change.

Since Bacon, educational psychology has emerged to investigate the nature of perception, and concept development and change. However this paper, because it is grounded in educational theory rather than

educational psychology, takes a different direction by first discussing the works of three more general and prominent authors thought to be germane to the question of concept and construct change.

The first of these three writers, Fromm (1976), in investigating the acquisitiveness and destructiveness of the human species, reveals a continuum of human kind ranging from a psychopathic, sociopathic, narcissistic end to a contemplative, reflective (metacognitive?[iii]) full-soled end. Fromm, who was interested in whether human destructiveness was learned (and therefore amenable to change through education) or innate, does not have good news. At best it is difficult for human beings to bring fundamental change to themselves. At the psychopath, sociopath, narcissistic end, change is almost impossible, which makes it all the more alarming that Gettler, (2003) found such types not only on big stages, but also in Ministries, and senior and middle level management in run of the mill organisations. Along the continuum, modification through incremental change, rather than substantial change, is his order of the day. Fromm's position is challenging for post-modern educational theory, which is increasingly constructivist. (Please see Tables 1 through 5 in the Appendix for a snapshot of constructivism.)

The psychopath-end group does appear to practice metacognition. But the *correct reason* which emerges appears unmoved by *right desire*. There is something unexplained about the "moral" vector in constructivism, whether this vector is thought of in terms of the traditional learned conscience kind, or the constructivist validation kind. Constructivism, it appears, has yet to face its postmodern twin (moral relativism) in a showdown for the higher moral ground. It may well be that sport can help bridge this impasse. The metaphor of sport (the game fairly played, the prize fairly won, under agreed upon and unifying rules) is powerful. It may well be that the transfer of training potential of sport, in both metaphor and practice, has been underexploited *in VET sector formal education and training* over the last decades. These questions will be pursued more fully in Section 2.2 below. This conference is, by inference, most significant and timely for both theory development and practice in formal vocational education and training.

The second author of the three, Kuhn (1970), differentiates between normal science and science in revolution and highlights the difficulty scientists (and science educators) face in leaving their paradigm enclaves. Science (knowledge, learning) progresses through paradigm shift which occurs through scientific revolutions involving *different sets of scientists*. Run of the mill paradigm shift occurs in different and sometimes successive sets of heads. Normal-science paradigm scientists continue to articulate the theory and even push its boundaries. Those wishing to investigate stubborn exceptions to articulation sooner or later must do so in a new paradigm. In essence, the paradigms pass like ships in the night with no, or at very best, hostile communication between them. Parts of the old have little place in the new. The old paradigm dies out with the passing of its last adherents, some of whom are influential and stubborn, making scientific progress (the growth of knowledge and learning through concept change) rarely a quick affair.

The third writer, Oakeshott, argues that experience exists as an indivisible totality but that humans can only access it partially through modes of experience. Such modes help the process of human understanding by dividing the totality into comprehensible forms. Each mode (for example the poetic mode, the scientific mode, the practical mode) does this by establishing its own criteria for self sufficiency. Modes manifest themselves through their (different) modal voices. One mode can never satisfactorily answer the concerns raised by another and may well ignore it, considering its criteria irrelevant or incomprehensible. Thus an ideal conversation of mankind – one in which 'there is no single universal truth to be discovered, no proposition to be proved, and no conclusions sought" (Oakeshott, 1962 p.198) – is impossible because voices compete, and a dominant voice emerges. The conversation becomes a dispute in which some voices are not heard. Others engage the dominant voice in primary counter discourse until they are subjugated or excluded. However it is possible for an inferior voice to colonise a dominant voice through secondary counter discourse. This occurs when a member on the periphery of the dominant voice is able to transform (present) the experience content of the secondary voice in the mode of experience of the dominant one. Thus there can be some degree of conversation between modes (voices) perhaps more than is permitted between Kuhn's different paradigm groups.

Three integrating observations, numbered in the box below, can be drawn from the macro theory discussion above:

1. Concept change and development is difficult for humans. Human condition barriers may well preclude the acquisition of substantial personal and social behaviour change in some individual humans. At the group and society level personal changes of the types under discussion, may, at best, take a long time to raise themselves to the level of social mores.
2. Constructivism in education is based on an anything-goes-if-it-works-for-me validation of new concept and constructs discovered. This, combined with moral relativism, can make the acquisition of coherent and socially unifying personal and social behaviour skills through formal education and training, doubly difficult.
3. Sport, which has many special characteristics, may well be underutilised in formal VET education and training as a medium for personal and social skills acquisition.

Points (2) and (3) above will now be explored further in Section 2.2.

2.2 Specific focus (educational theory) views about skills acquisition through concept change and development

To follow up on points 2 and 3: under constructivism, educational researchers have begun to investigate the process of skills acquisition through concept change and development in humans, and the efficacy of formal education and training in that process. Specifically constructivist research argues that individuals (students) actively construct their own understandings of the natural and person-made environments and validate these understandings (a) personally, on an "if it works use it basis" and (b) socially in various peer group settings. In this process humans learn how to hold multiple (and sometimes conflicting) "truths" coincidently. Consequently, classroom environment, teaching style and delivery method, and the prior concept and construct holdings of students, are not the only crucial vectors in the process of education and training viewed as social, intellectual, and skills advancement. Peer group, social mores, taboo, ritual, convention, myth, erotic muse, spirituality and religion are also important. Amongst all of this, teaching transactions relying on passive acceptance are somewhat "out". New methods which complement active construction are largely "in".

Tables 2 through 5 in the Appendix provide an overview of constructivist theory and a basis for the statements in the preceding paragraph. A perusal of these tables reveals just how demanding constructivist theory is for both teachers and formal education systems. The tables also reveal that constructivist theory is a post-modern phenomenon and like educational theory before it leaves questions unanswered. Nevertheless it can be used here for discussion purposes. Row 1 of Table 3 is reproduced below for convenience.

Table 1: Reproduction of row 1 of Table 3 in the Appendix

Domain	Hallmark
Constructivist Learning Environments (Jonassen)	According to Jonassen (1991) constructivist learning environments are characterised by: 1. Real-world environments that employ the context in which learning is relevant. 2. Realistic approaches to solving real-world problems. 3. Instructors who function as coaches and analysers of the strategies used to solve these problems. 4. A focus on conceptual interrelatedness providing multiple representations or perspectives on content. 5. Instructional goals and objectives that are negotiated rather than imposed. 6. Evaluation which serves as a self-analysis tool. 7. Tools and environments that help learners interpret the multiple perspectives of the world. 8. Learning that is internally controlled and mediated by the learner.

A perusal of the hallmarks column of Table 1 reveals that sport meets all the criteria of the constructivist environment. Games are played in real world situations with objects, realistic problem solving occurs within the games and so on. Radical constructivism excepted, sport maintains its high score when checklisted against all of the aspects of constructivism contained in Appendix Tables 2 through 5. Sport itself as a learning environment (as opposed to sports teaching) does not breach the requirements of constructivist theory.

However there is a general problem for constructivist theory in respect of acquisition of skills of the type under discussion here. Characteristics like honesty, trust, loyalty or for that matter cunning, chicanery and dissembling, whilst they are no doubt part of our world, belong to that category of phenomena that are one step removed from it. Unlike real world objects they do not have a tangible physical referent. It is easier for two observers to agree that a red dog is standing at the corner than it is for them to agree that an *honest* executive or politician is standing there let alone just an *honest* man or woman. So, on a simple technical basis, grasp of a full understanding of some of these skills states (honesty, loyalty etc) is difficult (as is acquisition of them) because the so called *real world* constructivist requirement is compromised[iv]. As if this is not enough, under moral relativism it is very difficult, and in some situations it is probably impossible, for humans to agree (or even to agree to disagree) on what constitutes appropriate personal and social skills behaviour. This occurs when the erotic, power, and imaginative aspects of the human mind, being infected with fundamentalism, ignorance and hatred, defeat human reason.

But in spite of the formidable nature of these barriers it will be argued below that sport can contribute considerably to breaking them down, mainly because its particular characteristics (a) allow the one step removed personal and social skills values to be accessed in a real and meaningful way and (b) provide a channel around the *anything-goes* validation and moral relativism of postmodern life. Outside of the formal theory domain, this claim amounts to the statement that humans can acquire substantial and valuable personal and social skills through sport. Whether there is transfer of acquisition from sport to career is another question. The authors believe that there is. Constructivist theory will be employed again to further investigate these claims.

Table 6 in the Appendix summarises some of the research domains of constructivism. Three of these theoretical domains (teaching for conceptual change, contrastive teaching and concept substitution) go directly to the core issue of learning viewed as concept change. Table 7 in the Appendix provides some general information about these areas of research. The three rows of Table 6 describing these research domains reveal, inter alia, that conceptual change can occur (a) through extinction of the prior concept, (b) through strengthening or weakening of the existing concept (assimilation or conceptual capture) resulting from its mental articulation, or (c) through exchange of one concept for another. Furthermore conceptual change is a function of *personal conceptual ecology* (the context for conceptual change) and necessary *conditions* for the change itself. *Personal conceptual* ecology resides in the options for choice and the criteria for choice and there is likely to be wide variation in conceptual ecology The *conditions* for change reside in an amalgam of opinions about the intelligibility, plausibility and fruitfulness of alternative constructs (in this paper's context the social and personal skills to be acquired) in respect to the learner's own situation. Unfortunately when *conditions* are right, *ecology* may inhibit acceptance of conceptual change as a result of epistemological or taboo belief holdings.

Sport can now be discussed in respect of the content of the preceding paragraph. Simply understood, sport happens when individual(s) participate in activity of their choosing. Such activity allows the full interplay of physical and mental abilities benchmarked against an agreed upon, owned and accepted set of rules. These rules exclude behaviour agreed upon as unacceptable and agreement of the rules is inherent in the individual's decision to participate. (Of course some will try to bend the rules.) Under the rules individuals can measure personal best performance and improvements in personal best. In short, for the greater part, sport removes many of the learning barriers inherent in differences in *personal conceptual ecology*. The rules of the chosen (owned or accepted) sport become the personal ecology for participants and level the playing field for the emergence of learned and innovative strategy and skills of the interpersonal and/or quiet achiever kind. On such playing fields the *conditions* under which participants test their own skills acquisition *intelligibility, fruitfulness and plausibility* manoeuvres are likewise the same for all, provided of course the umpires are honest. It is clear that sport as a medium supports all of the concept change methodologies named at (a), (b) and (c) in the preceding paragraph.

There is also another important dimension to sport, namely its affinity for metaphor. In England something unfair "is not cricket". In Australia, although an honest man or woman plays a "straight bat" they may still be aced, snookered, or even dropkicked in everyday career life! Australians who are not *straight shooters* are like suspect Americans judged by their colleagues as not quite being in the *right ballpark*. Tobin (1996) has identified universal *conditions* for change and three important educational *referents* upon which the *conditions* partly depend, and these are set out in Table 2 of the text. Tobin

points out that change is often sought without due regard being paid to the necessary and sufficient antecedent conditions both structural (educational/social/political/power/economic milieu) and mind (reason-interrogated cognition and imagination). Three educational theory approaches for facilitating the three kinds of concept change outlined above are identified.

The first, named the *analytical* approach, focuses on classroom teaching. It involves the use of educational action and strategy, and educational goals, interventions and outcomes defined in terms of commonly understood classroom objects, concepts and constructs. This is the realm of traditional teaching which employs known tools and techniques. The second, the *holistic* approach, uses metaphor as an image of (to imagine) practice, and through such imagination, and the metaphor switching it permits, to both catalyse change and provide a channel for that change. The third approach, the *metaphor/analytical,* is a combination of the first two in which analytical heuristic, although focussed on classroom phenomena as outlined in (a) above, is nevertheless grounded in metaphor and governed by the liberating imagination it permits. In the analytical approach, reason (metacognition?) mainly interrogates cognition; in the holistic approach, reason mainly interrogates the imaginative, fantastic, erotic and emotional depths of the soul; in the metaphor/analytical approach reason (metacognition?) attempts to draw understanding from an exploration of linkages and/or transactions that might be found within the cognitive-imaginative intersection. Tobin also outlines the essential components of metaphor, and these are also outlined in Table 2 of the text.

Table 2: Tobin's universals for change and components of referent and metaphor

Universal Conditions for Change

- Belief: viable knowledge which individuals employ for goal achievement.
- Action: behaviour predicated upon beliefs and goal aspirations but constrained by *ecology* (context and views about appropriateness). Such behaviour can be observed but linking it to beliefs, goal aspiration and appropriateness dimensions is not clear cut.
- Referent: that which serves as a guide to action and an organiser of beliefs and actions. Referent is thought to be specific to each context.

Three important educational referents

- teacher's personal epistemology,
- beliefs about control
- beliefs about restraints

Components of Metaphor

- a verbal part,
- an image,
- contexts within which the metaphor is thought to be viable

It is clear by inspection that sport, simply understood as described above, accommodates all three concept change environments. It has the extra advantage of being well suited for use in the *holistic* and *metaphor/analytic* domains making it all that more powerful in the *strengthen, extinguish* or *substitute* corridors of concept change.

The teaching implications of all this are that (a) clear definition of conceptual change must inform teaching and curriculum development, (b) conceptual ecology and learner condition constraints need to be considered, in so far as this is possible, in curriculum design and teaching strategy, and (c) personal epistemology, in so far as students recognise it or are willing to expose it, should also be probed. Ideally learners themselves should (a) want to understand the topic and own the understanding, (b) accept responsibility for their own learning, (c) be able to accept differing views about the subject and (d) be open in themselves to accept conceptual change. The works of Baird and White (1996), Gallagher (1996), Flavell, (1976), Hewson (1984, 1989), Posner. (1982) and (Treagust, Duit, & Fraser, 1996) are particularly relevant in respect of paving the way to a better understanding of inducements to change, and teaching for conceptual change.

It is now possible to make a fourth integrating observation in the development of the argument in this paper.

4. Sport because of its inherent characteristics goes a long way towards solving an impasse in constructivist theory, namely (1) the difficulty it faces in facilitating *unifying* (socially cohesive) validation and (2) the added difficulty imposed on validation by moral relativism. This aspect of sport appears not to have been investigated by the constructivist theory. Constructivist theory, on balance, supports the inherent potential in sport for social and personal skills acquisition.

The task of this paper now goes to a discussion of whether or not there can be transfer of skills learned through sport to career advancement. This will be done through the case study contained in Section 4.

4 A case study of the role of physical education in formal vocational education and training

Section 2 of this paper employed constructivist educational theory to put the view that social and personal skills can be learned through sport. The case study of an actual sport-in-VET innovation is now presented. One of the authors of this paper (Noela Eddington) was involved in the project. The case study supports the proposition that personal and social skills can be learned through sport and that it is very likely that such skills learned can be transferred to, and successfully used for, career development. Table 3 of the text sets out the main aspects of the case.

Table 3: Case study of a Sport in VET innovation

Domain	Explanation
Place and Time	The case took place in Queensland, Australia at the Eagle Farm College of Technical and Further Education in 1977, but is considered very relevant to the Conference theme, as well as to the current debate on the development of technical, cognitive and behavioural skills in Vocational Education and Training in Australia.
Student Cohort	The program was not designed for a special target group but government policy at the time was to offer it initially to socially disadvantaged students (16 – 25 years) to allow them to gain critical technical, cognitive and relational skills required by the labour market. The initial intake was 120 students, 119 males and one female.
Project Role and Purpose	The project, known locally as Work-related Human Movement Studies, was instigated as an integral part of a VET innovation known as Pre-vocational Education and Training. Pre-vocational training was introduced to complement traditional apprenticeship training and differed from the latter in that students, prior to being indentured as apprentices, were exposed to seven trades in one year, in a full time course of study. At this time the University of Queensland's Department of Physical Education had recently transformed itself into the Faculty of Human Movement Studies. Sport (physical education) was embedded in the syllabus and its role was to scaffold (a) a better cognitive grasp of the technical relationships between work and the human body and its occupational and environmental health needs, and (b) the development of the behavioural/relational skills so important in the work, leisure and life environments.
Methodology	(a) *Technical and Cognitive aspects*: (1) anatomy and physiology were taught in conventional classroom settings, (2) the concepts learned were then employed at the workface in applied exercises supervised by technical experts e.g. lifting and carrying with bricklaying, toxic fumes with welding and spray-painting, dust with carpentry and joinery, (3) the work/health relationships learned through (1) and (2) above were further investigated through traditional fitness testing and technical measurement of impacting environmental stresses e.g. noise levels, dust, fumes, lighting, ergonomics, equipment design, heat stress and so on. Both the student and instructor undertook and owned this testing. (b) *Behavioural/Relational aspects*: human relationships and communication, and all that these topics embody (conflict resolution, negotiation, clear and concise communication, honesty, trust, loyalty, team work, perseverance, accuracy, etc) were explored (awakened, called up) in the sports environment with the linkage to the work environment made specific. Skills were integrated in the technical workshop, the classroom and playing field; they were not segregated, thus leaving the student to make the connections between what is learned through sport and what is required in the workplace.

Staff Skill Sets	Three new staff were appointed to implement the innovation. These staff members were chosen on the basis of their expertise in physical education, communication and human relationships. The communications expert was male, while the other two were female. An interesting point about staffing was the way in which staff/student relationships developed: the youngest staff member became 'sister' and confidante to their drug and relationship problems, while the oldest member became 'mother' to their more general and health problems (medical, food, housing, and money).
Employer Expectations targeted through the Sport Component	Behavioural/social skills e.g. punctuality, honesty, respect for rules, ability to work independently or in teams, problem solving, perseverance, concentration, trust, loyalty, personal best performance.
Sports Involved	*Team development and relationship building*: football, cricket, volleyball, baseball, tennis, basketball, ten pin bowling. *Personal development and confidence building*: ice-skating, horse riding, archery, golf, orienteering, mountain bush walking, swimming, water skiing. *Personal strength and fitness*: weight lifting, gymnastics, javelin, discus, shot putt, gymnasium fitness circuit. *Complementary hobby activities for dexterity and personal development*: leather work, veneering and plastic laminating, chess, card games. Note: Some of these activities were conducted regularly in the college, whilst others were undertaken in the community or on away from campus residential camps.
Issues	The program was well resourced. The most critical issue (resistance from traditional trade teachers) seemed to dissipate as a result of their heavy involvement in residential camps. The work requirement that they take responsibility for a range of house keeping matters in the camps and also participate in the sporting activities, appeared to result in the acquisition, by some staff, of the skills being sought for their students.
Other Actors	The main external actor was industry: potential employers provided short term industry placements and evaluated the technical, cognitive and behavioural/social skills of the students.
Outcomes	A number of students left the course during the year. Of these, five withdrew for family reasons and six gained full time employment. Of the remaining 109, ninety-five gained employment upon completion of the course. This by normal standards is a very high success rate. Unfortunately, no long term assessment was undertaken, nor was there follow-up of those who failed to gain employment. It is important to note that the course was extremely intensive, with much time, effort and personal care being provided to students. It is uncertain whether the perceived transfer of training from sport to social skills explained the high job placement rate and whether it (the transfer of training from sport to work) was permanent. It is natural that some of the success could be Hawthorne-effect induced. The program ran for some 10 years from its inception, but finally fell to industry pressure for six month long, intensive, pre-apprenticeship courses in various one-trade-only areas. Successive phases of pre-vocational training in Queensland increasingly focused on technical and cognitive skills, and with the introduction of competency based training in the 1990s, the social behavioural skills were purported to be integrated with the technical and cognitive skills. **Key** personal, interpersonal and cultural understanding competencies (skills) were left to be somehow acquired during the acquisition of **core** skill competencies! (Please see Tables 8, 9 and 10 in the Appendix.) With the march of machine technology, and the poor success rate with social and personal skills acquisition methodology in VET in Australia, it is ironic that the two major industry and business associations in Australia are now calling for the VET system to deliver on the **key** social/behavioural skills required for employment.

5 Conclusion

Sport, by its very nature, is an activity through which personal and social skills can be acquired. Such skills acquired through sport can be used for social and career advancement. It is possible that in the VET sector in Australia, and elsewhere, this great potential of sport has been underutilised.

Appendix

Table 1: Francis Bacon's *idols of the tribe*

Idol	Explanation/Definition
Idol of the Tribe	The idols of the tribe are inherent in human nature, and the very tribe or race of man. For man's sense is falsely asserted to be the standard of things." (XLI)
Idol of the Cave	The idols of the cave "take their rise in the peculiar constitution mental or bodily, of each individual; and also in education, habit, and accident." The idols of the cave (den) are those of each individual. For everybody has his own individual den or cavern (in which the light of nature is corrupted) either from his own peculiar and singular disposition, or from his education and intercourse with others..." **(**XLII). A modern description might be individual prejudice.
Idol of the Marketplace	Idols of the Marketplace "are the most troublesome of all" "The idols of the market emerge from the commerce and association of men that converse by means of language". From language "arises a bad and unapt formation of words--a wonderful obstruction to the mind...words still manifestly force the understanding" (XLIII). "...men believe that their reason governs words; but it is also true that words react on the understanding...." "Whenever an understanding of greater acuteness or a more diligent observation would alter those lines [of the vulgar understanding of nature] to suit the true divisions of nature, words stand in the way and resist the change." "Learned men often end their discourse in disputes about words and names, so it would be more prudent to begin by considering them "and so by means of definitions reduce them to order" (LIX). Two impositions of words on understanding are "names of things which do not exist" and "names of things which exist, but yet confused and ill-defined" (LX).
Idol of the Theatre	Idols of the theatre arise from dogmas of philosophy--systems that "are but so many stage-plays representing worlds of their own creation" XLIV. (Kuhn's paradigms?)

Source: Adapted from Bacon, Francis (1957) *The Advancement of Learning (Novum Organon)*, Great Books of the Western World Series, Chicago: Encyclopaedia Britannica.

Table 2: Strands of constructivism

Category	Explanation
Trivial Constructivism	Trivial constructivism is the shorthand label for the view that knowledge is actively received not passively acquired. The human species (each capable one of us) actively constructs a personal reality. In the postmodern constructivist literature this daily act of trivial construction is referred to as Jourdain's[v] prose.
Radical Constructivism	Radical constructivism formally introduces questions of epistemology[vi]. Validation, that process through which humans discard old constructs for new (or remodel existing ones), allows the individual to determine which interpretations of "reality" are most viable: put simply to determine "what works best" for themselves. Truth is out and viability is in. Under radical constructivism different individuals can communicate using personally validated constructs not because they share identical meaning but rather by virtue of their shared meanings being compatible. In a discussion about cosmology for example, neither individual can ever know, (nor, for communication purposes needs to know) whether or not the sun actually does regularly appear. Discussions can go on about the sun provided there is sufficient commonality of personally validated constructs.
Social Constructivism	Social constructivism allows multiple actors in construction and multiple referents in validation. Significant modernist/post modernist researchers such as Vygotsky, (1978), and Solomon, (1987) admit that the individual is a social animal and argue that, as a consequence, active construction will employ *other* than so-called real (physical) world confrontations alone. Social constructivism is that school of constructivism that recognises that teachers, friends, others, institutions, culture and erotic muse, and myth can be enlisted in the erection of scaffolds to assist construction and engaged in social validation of that construction.
Critical Constructivism	Social constructivism emerged from acknowledgement of the human penchant for, and capacity to, engage in active criticism of their own, and others' constructs. Under this umbrella (critical constructivism) Taylor (1996) holds out the possibility that ongoing social and cultural reform might be understood (and "achieved") in a meaningful way. The question of ethics remains problematic for constructivism and constitutes a big challenge to further articulation of constructivism.
Constructionism	Constructionism allows that while many are active in critical constructivism others prefer to be spectators, some spectators even becoming intellectual voyeurs. By virtue of spectatorship, individuals can "own" innovation and change and become involved in innovation, change, and learning. Under constructionism, others observing a constructivist at work may themselves share (weakly or strongly) in that construction.

Source: Ernest, P. (1995). The one and the many. In P. Steffe & G. Gale (Eds.), *Constructivism in education* (pp. 459-486). Hillsdale New Jersey: Laurence Erlbaum Associates; Tobin, K., & Tippins, D. (1993). Constructivism as a referent for teaching and learning. In K. Tobin (Ed.), *The practice of constructivism in science education* (pp. 3-21). Washington: AAAS Press; Polkinghorne, D. E. (1992). Chapter 9: Postmodern epistemology of practice, *Psychology and postmodernism* (pp. 146-165): Sage; von Glasersfeld, E. (1995). *Radical constructivism: A way of knowing and learning*. London: Fulmer Press; Taylor, P. (1996). Mythmaking and mythbreaking in the mathematics classroom, *Educational studies in mathematics* (pp. 151-173). Dordrecht, The Netherlands: Kluwer Academic Publications Solomon, J. (1987). Social influences on the construction of pupil's understanding of science. *Studies in Science Education, 14*, 63-82; Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in quantitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research*. Thousand Oaks, CA: Sage.

Table 3: Hallmarks of constructivist curricula, method and teaching/learning environments

Constructivist Learning Environments (Jonassen)	According to Jonassen (1991) constructivist learning environments are characterised by: 1. Real-world environments that employ the context in which learning is relevant. 2. Realistic approaches to solving real-world problems. 3. Instructors who function as coaches and analysers of the strategies used to solve these problems. 4. A focus on conceptual interrelatedness providing multiple representations or perspectives on content. 5. Instructional goals and objectives that are negotiated rather than imposed. 6. Evaluation which serves as a self-analysis tool. 7. Tools and environments that help learners interpret the multiple perspectives of the world. 8. Learning that is internally controlled and mediated by the learner.
Constructivist Learning Environments (Honebein)	Teachers wishing, after Honebein, (1996) to establish a constructivist learning environment should: 1. Provide experience with the knowledge construction process. 2. Provide experience in and appreciation for multiple perspectives. 3. Embed learning in realistic and relevant contexts. 4. Encourage ownership and voice in the learning process. 5. Embed learning in social experience. 6. Encourage the use of multiple modes of representation. 7. Encourage self-awareness in the knowledge construction process.
Constructivism for Instructional Design (Jonassen)	Jonassen (1994) further argues that instructional designers wishing to capture the benefits of constructivism should: 1. Provide multiple representations of reality. 2. Represent the natural complexity of the real world. 3. Focus on knowledge construction, not reproduction. 4. Present authentic tasks (contextualizing rather than abstracting instruction). 5. Provide real-world, case-based learning environments, rather than pre-determined instructional sequences. 6. Foster reflective practice. 7. Enable context and content dependent knowledge construction. 8. Support collaborative construction of knowledge through social negotiation.

Constructivism and Teaching Style (Murphy)	Constructivist teachers will, after Murphy (1997): 1. Proceed with sensitivity toward and attentiveness to the learner's previous constructions. 2. Practice diagnostic teaching to remedy learner errors and misconceptions. 3. Pay attention to metacognition and strategic self-regulation by learners and the use of multiple representations of mathematical concepts. 4. Be aware of the importance of goals for the learner, and the dichotomy between learner and teacher goals. Be aware of the importance of social contexts, such as the difference between folk or street mathematics and school mathematics (and of attempts to exploit the former for the latter).
Cognitive Teaching Models which Embody Constructivist Concepts (Wilson and Cole)	Wilson & Cole (1991) identify concepts central to constructivist design, teaching and learning. Professionals will: 1. Embed learning in a rich authentic problem-solving environment. 2. Provide authentic as opposed to academic contexts for learning. 3. Provide for learner control. 4. Use errors as a mechanism to provide feedback on learners' understanding.

Source: Jonassen, D. H. (1991). Objectism vs. constructivism: Do we need a new philosophical paradigm shift? *Educational Technology: Research & Development, 39*(3); Jonassen, D. H., Wilson, B. G., Wang, S., & Grabinger, R. S. (1993). Constructivist uses of expert systems to support learning. *Journal of Computer-Based Instruction, 20*(3), 86-94; Jonassen, D. H., Campbell, J. P., & Davidson, M. E. (1994); Learning with Media N: Restructuring the debate. *Educational Technology Research & Development Journal, 42*((2).), 31-39; Murphy, E. (1977). *Constructivist learning theory*. Retrieved 21 September, 2002, from the World Wide Web: http://www.stemnet.nf.ca/~elmurphy/emurphy/cle2b.html ; Honebein, P. (1996). Seven goals for the design of constructivist learning environments. In B. Wilson (Ed.), *Constructivist learning environments*. Englewood Cliffs, NJ: Educational Technology Publications; Ernest, P. (1995). The one and the many. In P. Steffe & G. Gale (Eds.), *Constructivism in education*. Hillsdale New Jersey: Laurence Erlbaum Associates; Wilson, B. G., & Cole, P. (1991). A review of cognitive teaching models. *Educational Technology Research & Development Journal*.

Table 4: Summary of constructivist learning environments

1. Multiple perspectives and representations of concepts and content are presented and encouraged.
2. Goals and objectives are derived by the student or in negotiation with the teacher or system.
3. Teachers serve in the role of guides, monitors, coaches, tutors and facilitators.
4. Activities, opportunities, tools and environments are provided to encourage metacognition, self-analysis -regulation, -reflection & -awareness.
5. The student plays a central role in mediating and controlling learning.
6. Learning situations, environments, skills, content and tasks are relevant, realistic, and authentic and represent the natural complexities of the 'real world'.
7. Primary sources of data are used in order to ensure authenticity and real-world complexity.
8. Knowledge construction and not reproduction is emphasized.
9. This construction takes place in individual contexts and through social negotiation, collaboration and experience.
10. The learner's previous knowledge constructions, beliefs and attitudes are considered in the knowledge construction process.
11. Problem-solving, higher-order thinking skills and deep understanding are emphasized.
12. Errors provide the opportunity for insight into students' previous knowledge constructions.
13. Exploration is a favoured approach in order to encourage students to seek knowledge independently and to manage the pursuit of their goals.
14. Learners are provided with the opportunity for apprenticeship learning in which there is an increasing complexity of tasks, skills and knowledge acquisition.
15. Knowledge complexity is reflected in an emphasis on conceptual interrelatedness and interdisciplinary learning.
16. Collaborative and cooperative learning are favoured in order to expose the learner to alternative viewpoints.
17. Scaffolding is facilitated to help students perform just beyond the limits of their ability.
18. Multiple perspectives and representations of concepts and content are presented and encouraged.
19. Goals and objectives are derived by the student or in negotiation with the teacher or system.
20. Teachers serve in the role of guides, monitors, coaches, tutors and facilitators.
21. Activities, opportunities, tools and environments are provided to encourage metacognition, self-analysis -regulation, -reflection & -awareness.
22. The student plays a central role in mediating and controlling learning.
23. Primary sources of data are used in order to ensure authenticity and real-world complexity.
24. Knowledge construction and not reproduction is emphasized.
25. This construction takes place in individual contexts and through social negotiation, collaboration and experience.
26. The learner's previous knowledge constructions, beliefs and attitudes are considered in the knowledge construction process.
27. Problem-solving, higher-order thinking skills and deep understanding are emphasized.
28. Errors provide the opportunity for insight into students' previous knowledge constructions.
29. Exploration is a favoured approach in order to encourage students to seek knowledge independently and to manage the pursuit of their goals.
30. Learners are provided with the opportunity for apprenticeship learning in which there is an increasing complexity of tasks, skills and knowledge acquisition.
31. Knowledge complexity is reflected in an emphasis on conceptual interrelatedness and interdisciplinary learning.
32. Collaborative and cooperative learning are favoured in order to expose the learner to alternative viewpoints.
33. Scaffolding is facilitated to help students perform just beyond the limits of their ability.
34. Assessment is authentic and interwoven with teaching.

Source: Murphy, E. (1977). *Constructivist learning theory*. Retrieved 21 September, 2002, from the World Wide Web: http://www.stemnet.nf.ca/~elmurphy/emurphy/cle2b.html

Table 5: Ways to probe prior construct understanding without huge interruptions to class time

Probe Type	How the Probe Might be Undertaken Without Prohibitive Interruptions to Class Time
Naturalistic Setting Techniques	The teacher can develop in themselves a permanent observational stance. This can be applied with time efficacy during croup work and or concept mapping segments of day-to-day lesson delivery. The teacher here is interested in forming a general understanding of the range of prior understandings held by the cohort members. A recording proforma may be useful as a kind of checklist which may allow the teacher to apply Pareto optimisation in general teaching strategy with follow up through graded remedial exercises to catch those deficiencies not Pareto addressed.
Interviews	Interviews might be used in a time efficient manner if they are reserved for cases resistant to access by other more generally applicable techniques like concept mapping and computer diagnostics. Interview might also pay time dividends benefits if they reveal other than prior construct inhibitions to stronger construction.
Techniques for Accessing Conceptual Relationships	Concept mapping procedures might be time efficient if they are used as a validation methodology in which pairs each validate the other's work first against their own and then against a preferred template or checklist. Whilst the teacher may well receive less feedback themselves under this use strategy it would be time saving. Unfortunately it may disproportionally favour the more active and motivated students. However in time such a use might result in a "natural pairing" alliances which themselves could be very instructive. Those pairs consistently scoring poorly could then be targeted to gain more insight into their understanding and how to improve it.
Diagnostic Testing	Given the busy time schedules of teachers and the fiduciary requirements for ongoing and consistent testing and moderation for final understanding purposes, diagnostic testing for prior understanding, except in the early stages of a term is not recommended.
Computerised Diagnosis	This facility is time efficient when it can be set as an after hours laboratory component of ongoing classroom activity. Group computer work often benefits the keyboard operator more than the onlooker and care should be taken to rotate the keyboard user position.

Source: Treagust, D. F., Duit, R., & Fraser, B. F. (Eds.). (1996). *Improving teaching and learning in science and mathematics*. New York: Teachers College Press.

Table 6: Some constructivist research domains

Domain	Specific Theoretical Ideas	Corollary
Curriculum Development as Research: A Constructivist Approach to Science Curriculum Development and Teaching	●Individuals construct and restructure their schemes of the world. ●Scientific knowledge itself is constructed socially. ●Science learning is something like being introduced to ways of seeing. ●Scientific learning is about making links between informal (intuitive, old) ways of seeing and scientific (new, formal) ways of seeing. Cognitive awareness (in the learner and teacher) (a) of the different rule sets operating in each of the "old" and "new' domains, and (b) of the different social contexts in which the rule sets apply, is central to this process. ●The ideas above should tailor teaching strategy and instructional design for the serious business of concept change and development.	●Curriculum development/teaching as research is labour intensive and cannot be rushed: three years for this experiment. ●As in every experiment curriculum development/teaching as research is methodical requiring clear definitions, logical step by step progression and transparent research design: three steps in this case three steps with each step requiring considerable time and energy expenditure. ●Paired work on graded activity designed to prompt expression of thought was used to elicit prior concept. Elicited concept can be displayed on posters. Hands on activity has been found to be a powerful provoker of thought and discussion. ●Having students first construct their own theories about the subject under investigation can fit well with later concept substitution of the accepted view. ●Learning activities are more often than not, domain specific and this prevents the easy discovery of general rules and analogues for CSD curriculum design
Strategies for Remediating Learning Difficulties	1.Students hold ideas different from the accepted scientific view. These intuitive ideas are sometimes consistent with science but can also be confused.	●Prior construct holding may not indeed be as postulated in CSD (that is having sufficient commonality for general strategy planning) bit rather may be confused, inconsistent, varied and scattered. ●Substantial implementation barriers may exist: teachers, teacher educators, and curriculum developers necessary to curriculum development/teaching as research may have prior knowledge belief systems of such status as to override the findings of their own research. Alternatively time and energy constraints may prohibit implementation of findings. ●Three conditions are thought to drive learning difficulty (resistence to concept change and development): (a) the prior knowledge system of the learner, (b) learning task complexity relative to the information handling capacity of the student, and (c) language/communication barriers inherent in (1) scientific jargon, and (2) teacher sentence construction/syntax relative to those of the student cohort. As a consequence teaching practice should be predicated upon (a) diagnosis of learning difficulties and accommodating behaviour, (b) interpretation of the learning difficulties and isolation of their source, (c) treatment of the difficulties by by-pass and/or remediation, and (c) evaluation of the teaching/curriculum strategy inherent in (a), (b) and (c) above. (In safety science such a process is called risk management.) ●Again, curriculum development/teaching as research is labour intensive and cannot be rushed. As in all experimental activity, curriculum development/teaching as research is methodical requiring clear definitions, logical step by step progression and transparent research design: four steps in this case with each step requiring considerable time and energy expenditure.

		●Textbook content and structure combined with teaching method was found to be implicated in learning difficulty in Israel. ●
Teaching for Conceptual Change	●That prior student knowledge holding is crucial in intellectual activity is widely held. ●Prior knowledge holding is diverse and can contradict accepted scientific views. ●Learning is not passive acceptance but rather active conceptual change and development. ●Metacognition and metaconception are essential for the processes of conceptual change and conceptual development. ●Conceptual change can occur (a) through extinction of the prior concept, (b) through strengthening or weakening of the existing concept (assimilation or conceptual capture) resulting from its mental articulation, or (c) through exchange of one concept for another. ●Conceptual change is a function of conceptual *ecology* (the context for conceptual change) and necessary *conditions* for the change itself. These conditions are an amalgam of opinions about the intelligibility, plausibility and fruitfulness of alternative constructs in respect to the learner's own situation. Conceptual change involves a reordering of constructs in the status hierarchy of constructs. When *conditions* are right, *ecology* may inhibit as a result of epistemological belief holdings. ●Teaching for conceptual change requires (a) the range of prior existing views about a topic be made explicit, (b) that both teacher and student contribute to the cataloguing listing of these views, and (c) that the views of both students and teachers should, in the first instance, be considered as equals in that they should not attain status on the basis of the status of the utterer.	●Metacognition is essential in curriculum design/teaching as research approaches to conceptual change. ●Clear definition of conceptual change must inform teaching/curriculum development as research experimentation. ●Conceptual ecology and learner condition constraints need to be considered, in so far as this is possible, in curriculum design and teaching methodology strategy. Important elements in the conditions vector are intelligibility, plausibility and fruitfulness. ●Personal epistemology, in so far as students recognise it or are willing to expose it, should also be probed. ●Guidelines for eliciting different views: (a) consider students' views alongside teachers' views, (b) give equal status of expression to the views of teachers and students. ●Guidelines for changing the status of some views: personal ecology is a function of options for choice and criteria for choice and there is likely to be wide variation in conceptual ecology. Explanations of desired understandings of causal mechanisms under consideration must take this diversity into account and to some extent go Pareto with remedial activity for those outside. ●Teacher roles helpful in teaching for conceptual change: (a) manager of appropriate classroom climate – context for classroom activity, posing of appropriate questions, unthreatening exploration of underlying ideas, task selection, and setting and explanation of behaviour ground rules, (b) active participant – balance between leader voice and discovery learning voice, hearing of both student and teacher views, respect for students, wide repertoire of teaching material and resource materials, and metacognition about his/her own understandings about the nature of teaching and learning. ●Learner roles helpful to teaching for conceptual change: (a) learners must want to understand the topic and own the understanding, (b) learners must accept responsibility for their own learning, (c) be able to accept differing views about the one subject, (d) be open in themselves to accept conceptual change intuitive knowable to them as higher status change. ●Classroom climate suitable for teaching for conceptual change: (a) respect for multivocality of ideas, (b) freedom from fear of ridicule because of the expression of ideas which are contrary, or because they seek further clarification (c) separation of person from idea in that ideas are critiqued yet the person remains affirmed (group work is useful), (d) agreement that the goal of the lesson is the acceptance of shared (correct) meanings about a topic adopted for their own intrinsic status and not on the basis of teacher say-so.

Contrastive Teaching: A Strategy to Promote Qualitative Conceptual Understanding of Science	●Without being aware of their prior intuitive notions about a scientific concept or construct, students will find great difficulty in learning the accepted scientific notion of it/them. ●Prior knowledge holdings by students affect the progress of learning and are important for teaching, learning and curriculum design. ●Meta-analysis is an essential crucial factor in student learning.	●Again teaching/curriculum development as research is labour intensive, long term, and demanding on energy and time. ●Teaching/curriculum development as research requires viable research methodology and design (6 phases in this case), informed researchers, and clear definition of terms.
Concept Substitution: A Strategy for Promoting Conceptual Change	●Student ideas that conflict with accepted scientific ideas are difficult to change by instruction. ●Two theoretical approaches to conceptual change and/or the resolution of conflicting perspectives are: (1) cognitive conflict and (2) the build on learner's existing ideas (concept substitution) approach.	●Is more suited to situations in which the pathway from the student's intuitive conceptions to preferred science conceptions is continuous because those intuitive understandings (which unfortunately are expressed in inappropriate terminology) are essentially correct.

Source: Treagust, D. F., Duit, R., & Fraser, B. F. (Eds.). (1996). *Improving teaching and learning in science and mathematics*. New York: Teachers College Press.

Table 7: General information about three constructivist research domains

Teaching for Conceptual Change (TCC)	TCC is a curriculum development research experiment which (a) explores operational definitions of conceptual development and conceptual change, (b) applies the explored clarified definitions to the discovery of general guidelines for teaching and (c) identifies teacher, learner and classroom environment vectors constituting necessary conditions for those guidelines.	The researchers follow Flavell (1976) in stressing the crucial importance of metacognition in teaching for conceptual change and cite Thorley's (1990) further articulation of this issue. The researchers ground their experiment in the Cornell University model for conceptual change (CCM) in both its original and articulated forms (Hewson, 1982; Hewson, 1981; Posner, Strike, Hewson, & Gertzog, 1982)
Contrastive Teaching (CT)	CT is a curriculum development research experiment in which contrastive teaching is used facilitate cognitive distinction by students between their intuitive views about specific science topics and the preferred views claimed by science as theory laden observation	The researchers use Neidderer and Schecker's contrastive teaching strategy as scaffolding for their experiment (Niedderer & Schecker, 1982a, 1982b).
Concept Substitution (CS)	Concept substitution is a CDR experiment aimed at developing teaching strategy in which concept substitution (rather than cognitive conflict) is used to match and fix accepted physical terms (constructs) with correct prior intuitive understanding. Concept substitution is (after Duit) a continuous path process in which students' correct intuitive ideas (concepts and constructs) are reinforced through participation in teaching and learning experiences during which an intuitive nomenclature is replaced by the preferred scientific nomenclature.	The particular CDR-CS experiment outlined draws on conceptual change research (Duit, 1993; Hewson & Thorley, 1989; Jung, 1986; Minstrell, 1984; Scott, Asoko, & Driver, 1992) awakened by constructivist.

Source: Treagust, D. F., Duit, R., & Fraser, B. F. (Eds.). (1996). *Improving teaching and learning in science and mathematics*. New York: Teachers College Press.

Table 8: The Finn **key** areas of competence

Competency name	Competency area of operation
Language and communication	1. Speaking 2. Listening 3. Reading 4. Writing 5. Accessing and using information
Mathematics	1. Computation 2. Measurement 3. Understanding mathematical symbols
Science and technological understanding	1. Scientific and technological concepts 2. Impact of science and technology 3. Scientific and technological skills
Problem solving	1. Analysis 2. Critical thinking 3. Decision making 4. Creative thinking 5. Skills transfer and new contexts
Personal and interpersonal	1. Personal management 2. Negotiating, team skills 3. Initiative, leadership 4. Adaptability to change 5. Self esteem 6. Ethics
Cultural understanding	1. Australia's context 2. Global issues 3. World of work

(Source: Committee to Advise the AEC and MOVEET on Employment–Related Key Competencies for Post Compulsory Education and Training 1992*, Putting General Education to Work*, no city, p. 4.)

Table 9: Mayer or **key** competencies.

Competency area of operation	Definition
Collecting analysing and organising information	The capacity to locate information, sift and sort information, in order to select what is required and present it in a useful way, and evaluate both the information itself and the sources and methods used to obtain it.
Communicating ideas and information	The capacity to communicate effectively, with others using the range of spoken, written, graphic and other non verbal means of expression.
Planning and organising activities	The capacity to plan and organise ones own work activities, including making good use of time and resources, sorting out priorities and monitoring one's own performance
Working with others and in teams	The capacity to interact effectively with other people both on a one to one basis and in groups, including understanding and responding to the needs of a client and working effectively as a member of a team to achieve a shared goal.
Using mathematical ideas and techniques	The capacity to use mathematical ideas such as number and space and techniques such as estimation and approximation for practical purposes.
Solving problems	The capacity to apply problem solving strategies in purposeful ways, both in situations where the problem and the desired solution are clearly evident and in situations requiring critical thinking and creative approach to achieve an outcome.
Using technology	The capacity to apply technology, combining the physical and sensory skills needed to operate equipment with the understanding of scientific and technological principles needed to explore and adapt systems.
Cultural understanding (Added 1996 after Rumsey and Hannan)	The capacity to apply an understanding of the nature and diversity of ideas, values, knowledge, traditions and practices operating in a particular workplace and influencing the wider contexts in which the enterprise or institution functions.

(Adapted from Committee to Advise the AEC and MOVEET on Employment–Related Key Competencies for Post Compulsory Education and Training 1992*, Putting General Education to Work*, no city, p.3)

Table 10: The 8 Australian Standards Framework levels of **core** competency

		Level of **Core** Competency							
Column Number		1	2	3	4	5	6	7	8
Competency at this level involves-	1	Application of skills and knowledge to a limited range of tasks and roles	A wider range of skills and knowledge applied	Knowledge with depth in some areas and a broad range of skills	Broad range of skills - depth in some areas applied	Substantial depth in some areas applied	Substantial depth across a number of areas	Mastery of broad and/or specialised skills	Mastery over range of skills and knowledge
Competencies are normally used-	2	Within established and predictable routines	Within established routines, methods and procedures	Within routines. methods and procedures where some discretion and judgment required	Within routines, methods and procedures where discretion and judgement is required	Independently and both routinely and non-routinely	Independently and both substantially non-routine	Independently and non-routine	Within full independence over routine and non-routine areas
Judgement, innovation and choice of actions-	3	Judgement against established criteria	Some discretion and judgement about possible actions	Some discretion and judgement in selection of equipment, work, organisation, services, actions, and achieving outcomes within time constraints	Some discretion and judgement for both self and others in planning and selection of equipment, work organisation, services, actions, achieving outcomes within time restraints	Judgement required in planning and selecting equipment, services, techniques and work organisation for self and others	Significant judgement in planning. design technical and supervisory functions related to products, services, operations or processes	Significant high level of judgement required in planning, design operational, technical and/or management functions	Highest level of complex judgement applied to planning, design technical and/or management functions
Responsibility and accountability for-	4		Responsibility for some roles and co-ordination may be involved if working in a team	Responsibility for the work of others and/or team co-ordination may be involved	Responsibility for, and organisation of, the work of others may be involved	Responsibility for the planning and management of others may be involved	Responsibility and defined accountability for the management and output of the work of others for a defined function or functions may be involved	Responsibility and broad ranging accountability for the structure, management and output of the work of others and/or functions may be involved	Full responsibility and accountability for all aspects of the work of others and functions, including planning, budgeting and strategy
Competencies applied-	5	Under direct guidance with regular checking, but may be less direct with some autonomy if working in teams	Under routine guidance with intermittent checking	Under limited guidance with checking related to overall progress, but may take form of broad guidance and autonomy if working in teams	With only general guidance on progress and outcomes	Under broad guidance	Limited guidance in line with a broad plan, budget or strategy	In accordance with a broad plan, budget or strategy	Involving full responsibility and accountability
Range of tasks, roles and contexts	6	Specified where the choice of actions is clear	Defined where the choice of actions is usually clear, with limited scope in choice	Variety of contexts with some complexity in the extent and choice of actions required	Variety of contexts with complexity in the range and choice of actions	Variety and highly specific	Major functions in either varied or highly specific contexts	Highly varied and/or highly specialised	Highly varied and/or highly specialised major functions or specialisations

Source: Thomson, Peter 1994, *Getting to Grips with Developing Competency Standards,* NCVER, Leabrook, p. 48-49.)

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[i] The topics of the conference are/were (1) integrating the practice of a sport into formal vocational education and training, (2) incorporating sporting activities into enterprise based training, (3) cooperation projects between training institutions and sporting organisations which meet the needs of informal learning, and (4) identifying priority themes for education and training that sporting activity can promote, such as teamwork, self confidence, participation, solidarity etc.

[ii] Management texts discussing the personal characteristics of successful businessmen find the "good" characteristics (charm, charisma, energy, confidence, vision, gregariousness, kindness, fairness and the like) well matched by the presence of "bad" characteristics (cunning, stealth, chicanery, selfishness, bullying, vanity, and the like). The question is vexing. And it is well known that, from the time of the very first Olympic Games, national and international interests have used the institution of sport as a power for good (environmental sustainability and human rights purposes) or bad (nationalistic jingoism and divisive mythmaking) – again a vexing question.

[iii] Metacognition, operationalised for educational theory purposes, is knowledge about, and awareness and control over, personal practice and behaviour. Metacognition requires that the student engages in informed purposeful activity and active control over personal learning approach, learning progress and learning outcome. Metacognition occurs when reflection informs action, reflection itself being understood as honest introspection about what the individual is doing and why they are doing it. Action is understood as observing, manipulating, applying procedures and enacting decisions.

[iv] This is not to say that Australians can't recognise a bastard when they see one! But then again does it take one to know one! Noetic understanding is vexing and complex.

[v] Referred to by von Glasersfeld, the nouveau riche Monsieur Jourdain in Moliere's Bourgeois Gentilhomme discovered to his astonishment that he had always been speaking prose.

[vi] It is interesting to note von Glasersfeld's working comment on this: "It is an attempt to explain a way of thinking and makes no claim to describe independent reality. That is why I prefer to call it an approach to or a theory of knowing. Though I have used them in the past, I now try to avoid the terms 'epistemology' or 'theory of knowledge' for constructivism because they tend to imply the traditional scenario according to which novice subjects are born into a ready made world, which they must try to discover and 'represent' for themselves' (pp.1-2).